Spiny Water Flea Monitoring on Lake Winnipesaukee, NH

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NHDES

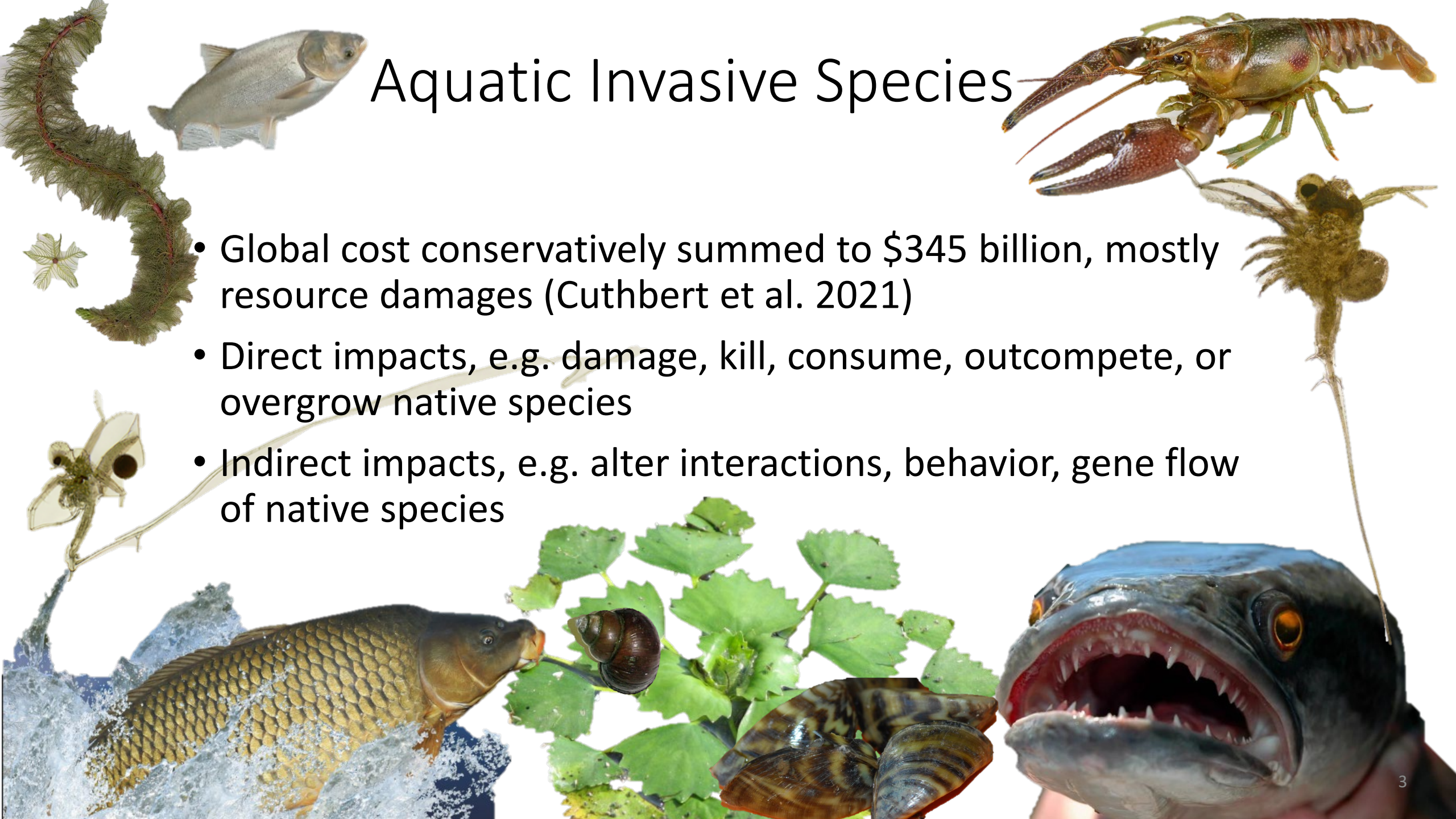
Special thanks

Amy Smagula

Josh Buonpane

Aquatic Invasive Species

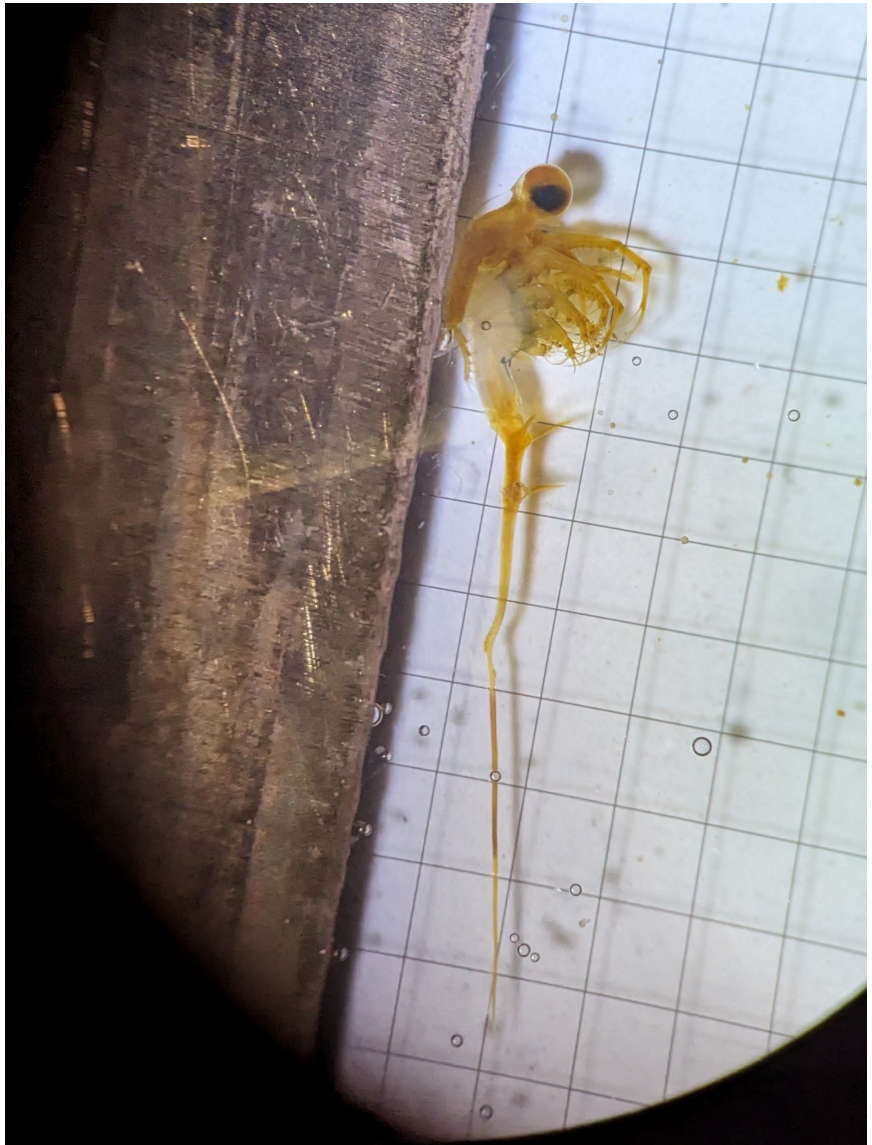
- Global cost conservatively summed to $345 billion, mostly resource damages (Cuthbert et al. 2021)
- Direct impacts, e.g. damage, kill, consume, outcompete, or overgrow native species
- Indirect impacts, e.g. alter interactions, behavior, gene flow of native species



Spiny Water Flea

- *Bythotrephes cederströmii* (also used: *Bythotrephes longimanus*)
- First discovered in 1984 in Lake Huron
  - In all Great Lakes by 1987
- Up to 15 mm (0.6 in) long
- Native to Europe and Asia
- Prefers large, low-nutrient, temperate lakes
- Not harmful to humans
- Direct and indirect impacts have been documented

Spiny Water Flea in New Hampshire

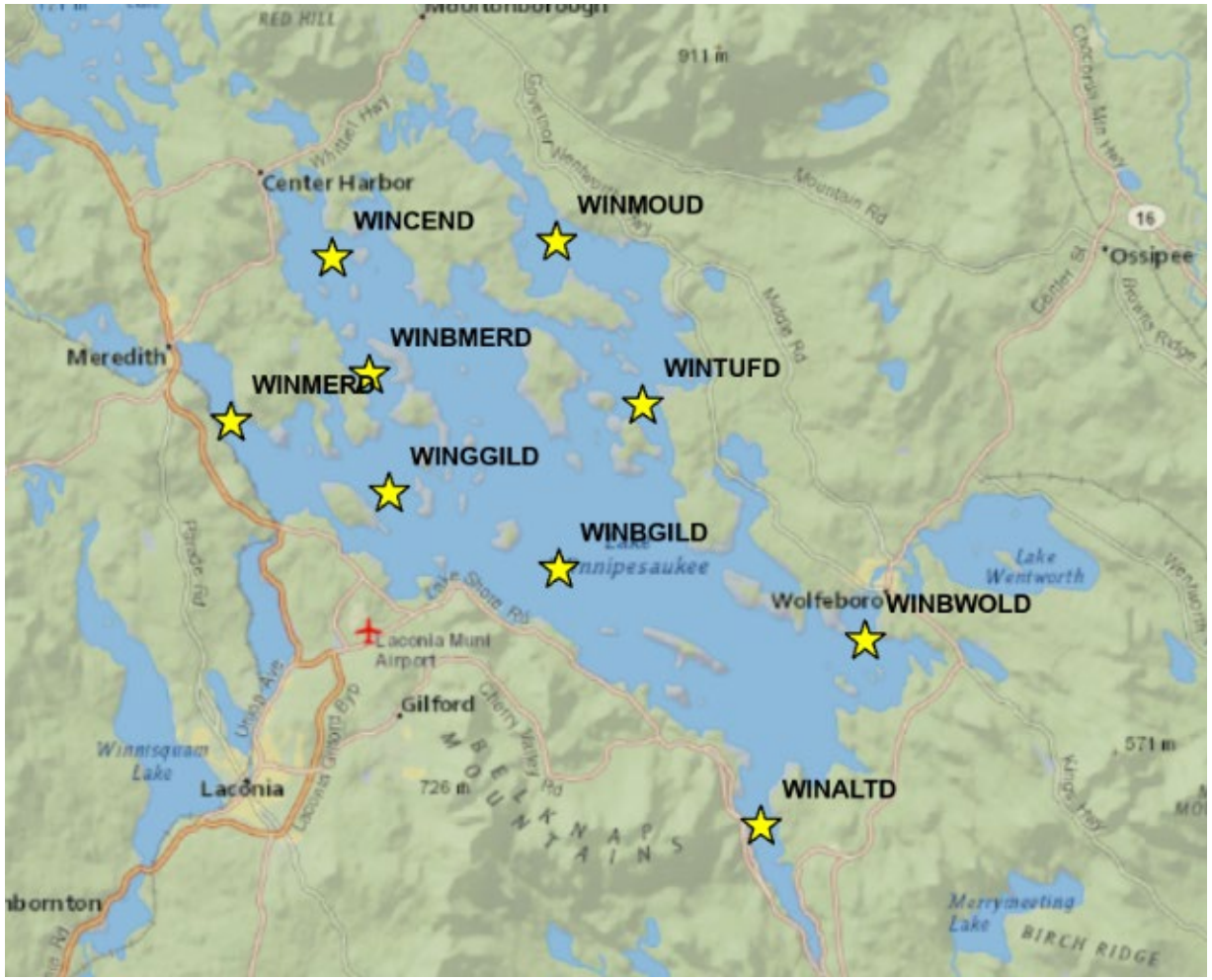


- First documented in Lake Winnipesaukee in September 2023
  - First record of SWF in New Hampshire
- Lake Winnisquam – 2023
- Newfound Lake - 2025

Unexpected?....

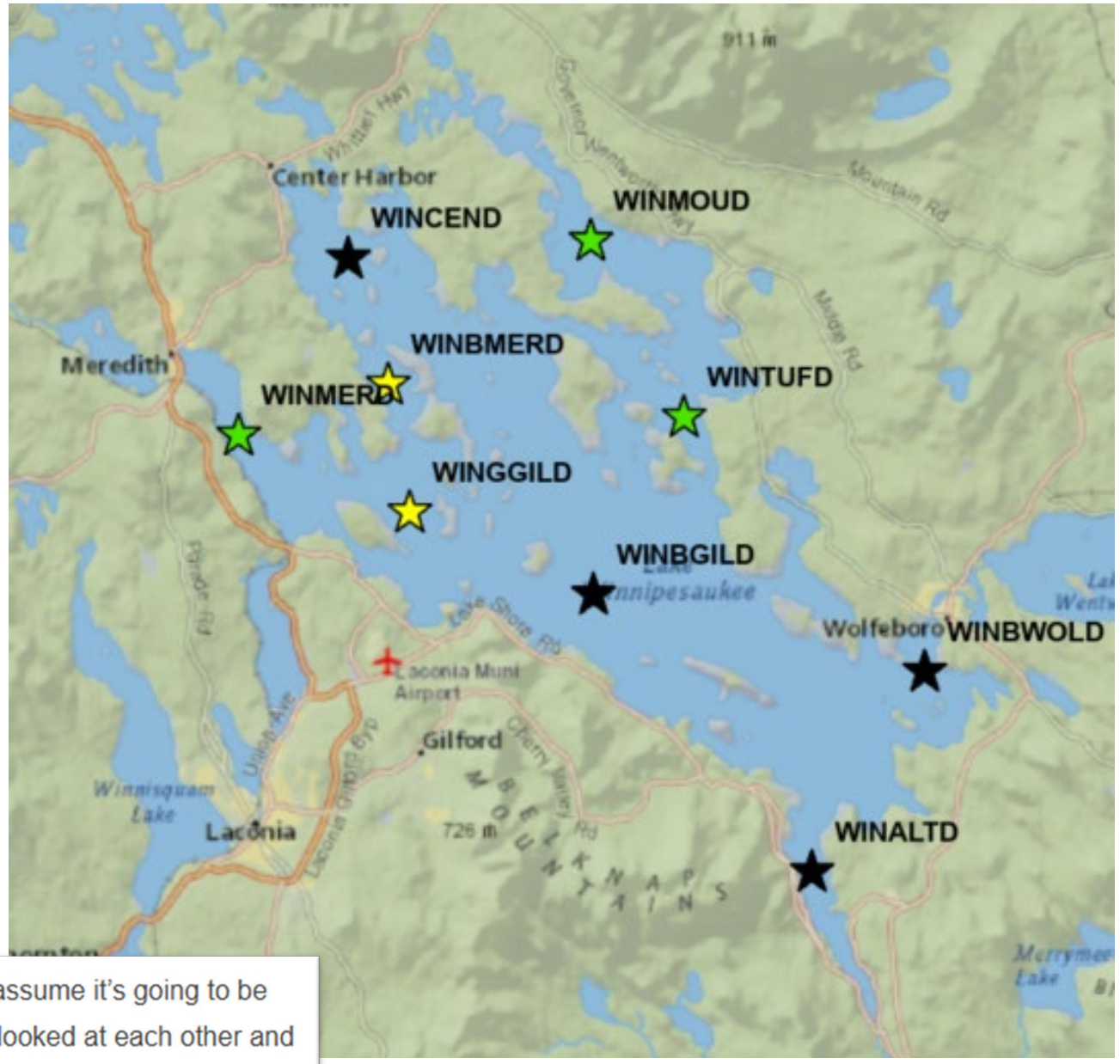
Monitoring History

- Started in 2016
- Nine deep spot locations on Lake Winnipesaukee
- Once a year, ideally target late summer but scheduled around required field work
- Horizontal tow
  - 80-µm mesh net for phytoplankton & rotifers
  - 250-µm mesh net for SWF & other microzooplankton
- 2016 was pilot study
  - Ironing out the monitoring and sample processing protocols
  - Data analyses to focus on 2017 - 2025



Monitoring History

- Spiny Water Flea detected in 2023
- SWF Detection
  - Green – no SWF found in sample
  - Yellow – SWF spine observed in sample
  - Black– SWF observed in sample
- 4 out of 9 stations in 2023

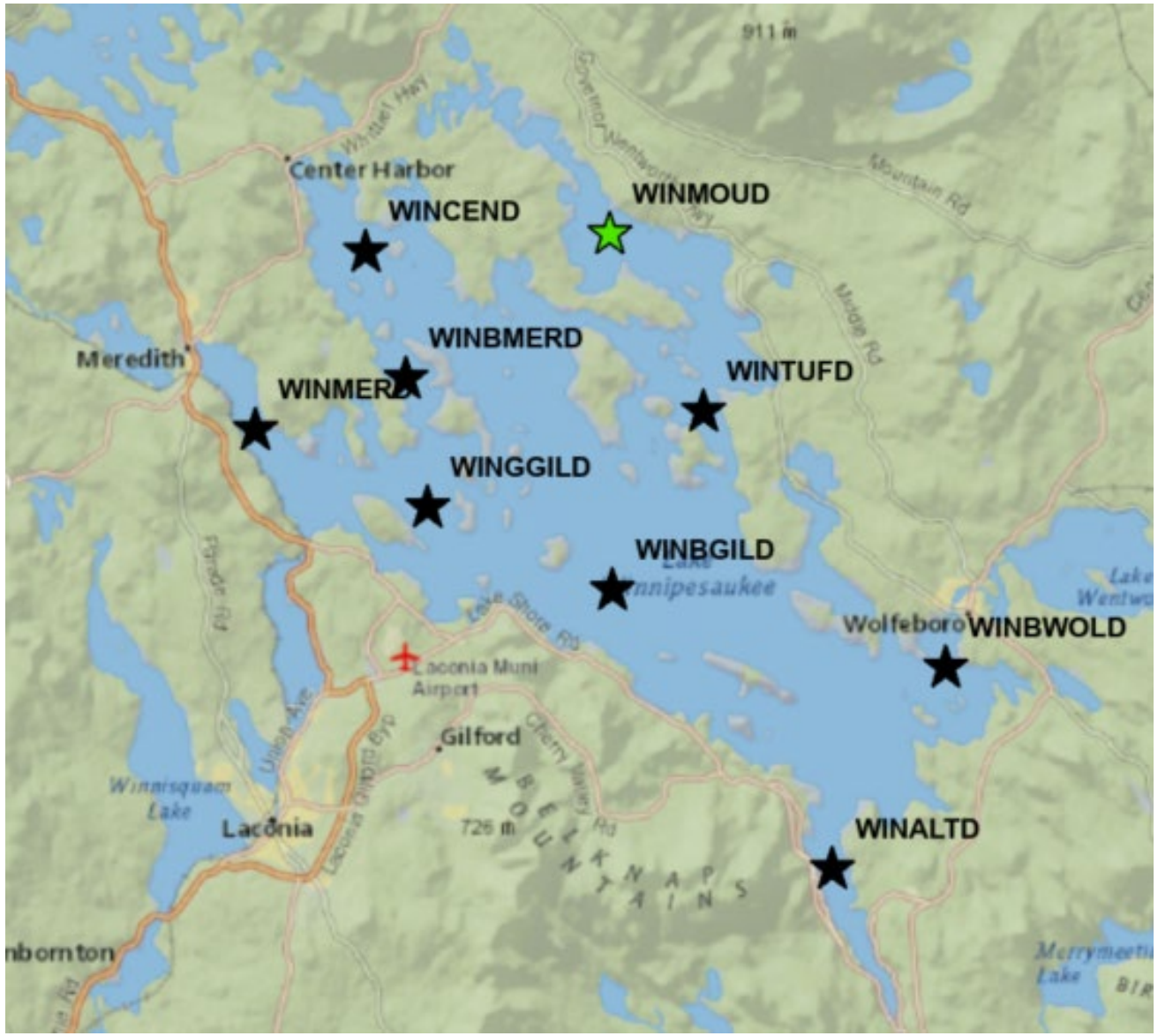


"It was a little surprising, after monitoring for eight years and not finding it. You assume it's going to be another good year," Smagula, a limnologist, said about that moment. "We both looked at each other and said, 'Oh, shoot!'"

10/3/23 *Laconia Daily Sun*

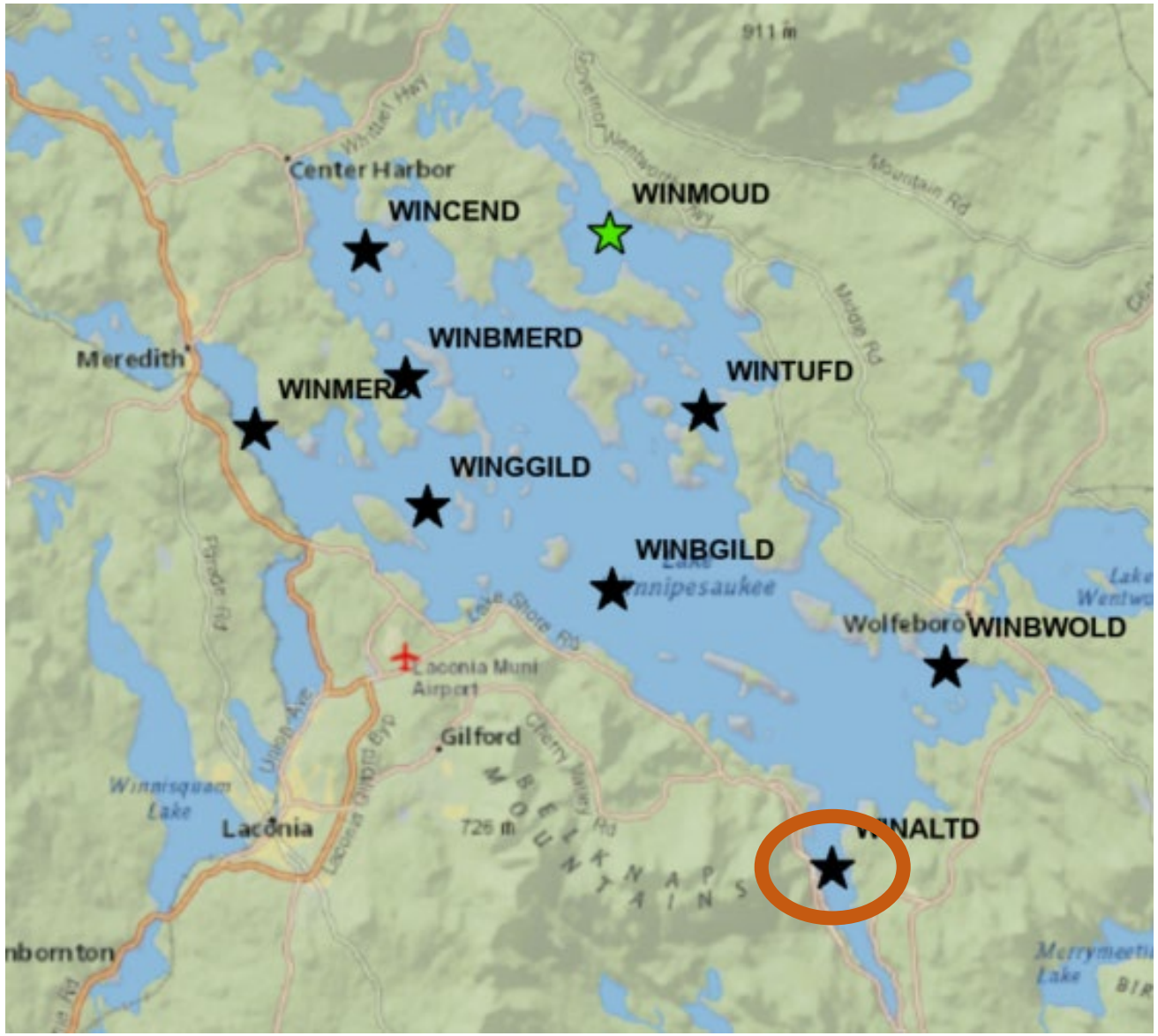
Monitoring History

- Spiny Water Flea detected in 2023
- SWF Detection
  - Green – no SWF found in sample
  - Yellow – SWF spine observed in sample
  - Black – SWF observed in sample
- 8 out of 9 stations in 2024



Monitoring History

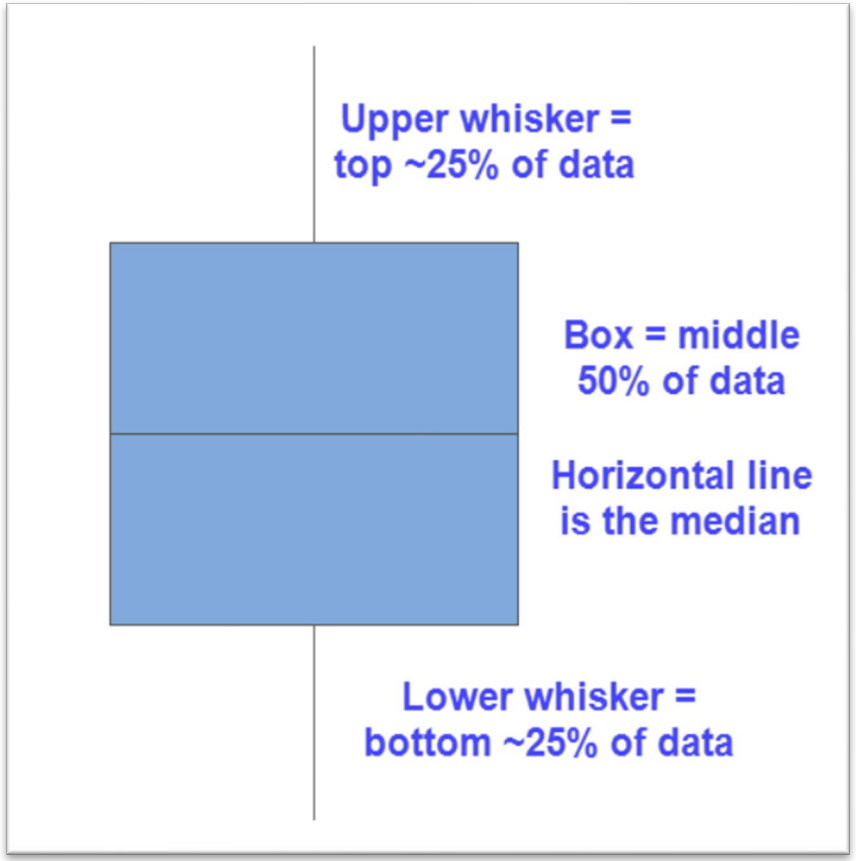
- Spiny Water Flea detected in 2023
- SWF Detection
  - Green – no SWF found in sample
  - Yellow – SWF spine observed in sample
  - Black – SWF observed in sample
- 8 out of 9 stations in 2024
- 7 out of 9 stations in 2025



Spiny Water Flea – Any noticeable effects?

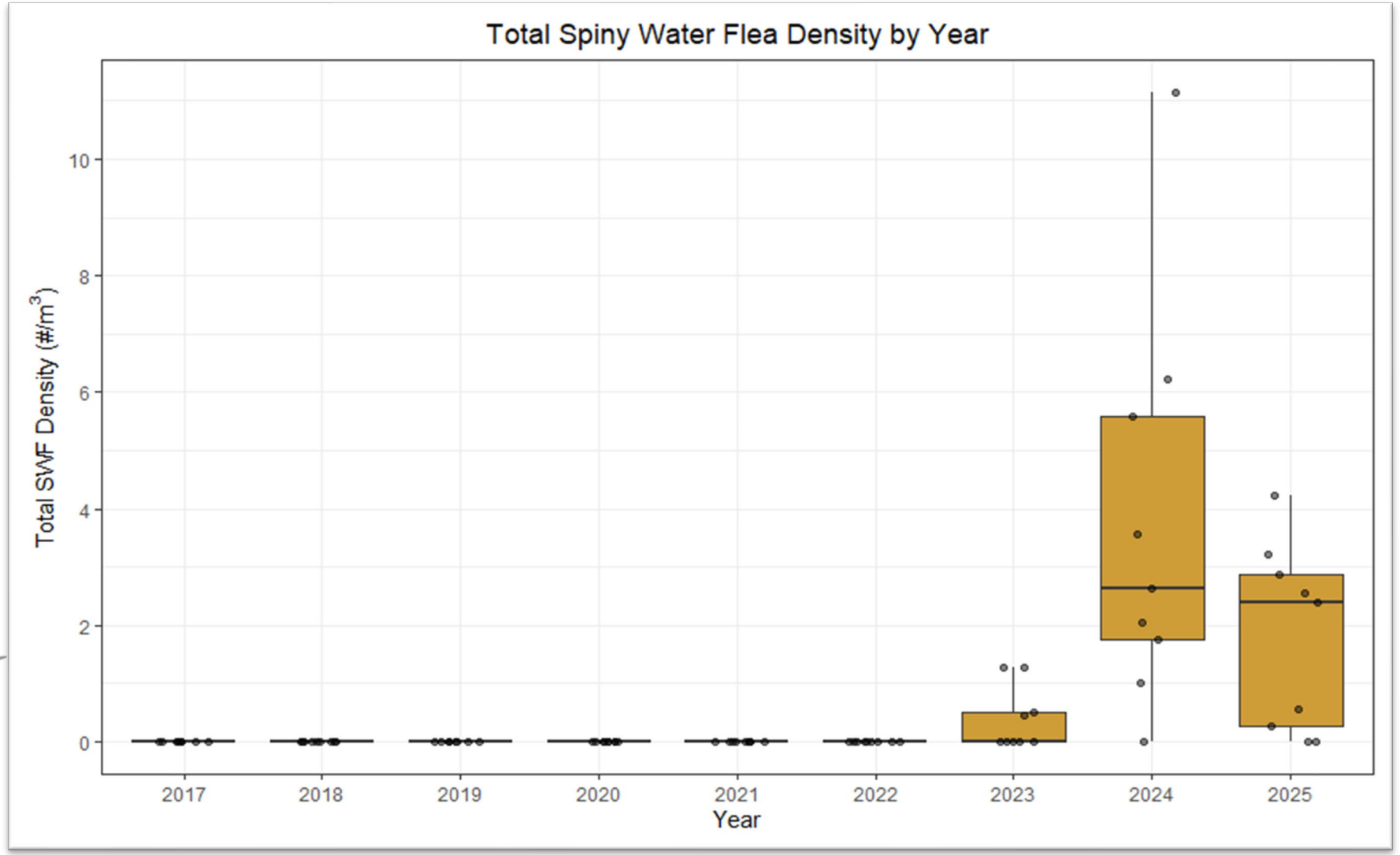
- First step
  - Mann-Kendall Trend Tests
  - Boxplots
  - 3 separate datasets
    - 250-um macrozooplankton
    - 80-um zooplankton
    - 80-um phytoplankton
  - Grouping
    - E.g. Cladoceran, Copepod, Rotifer

- Previous Research
  - Declines in Daphnia (Walsh et al. 2018, Cutter et al. 2023, Young et al. 2024)
  - Increase in Diatoms (Walsh et al. 2018)
  - Decline in Cyclopoid Copepods, bosminids, Leptodora, & rotifers (Cutter et al. 2023)
  - Decrease in large-bodied zooplankton (Marin et al. 2022)



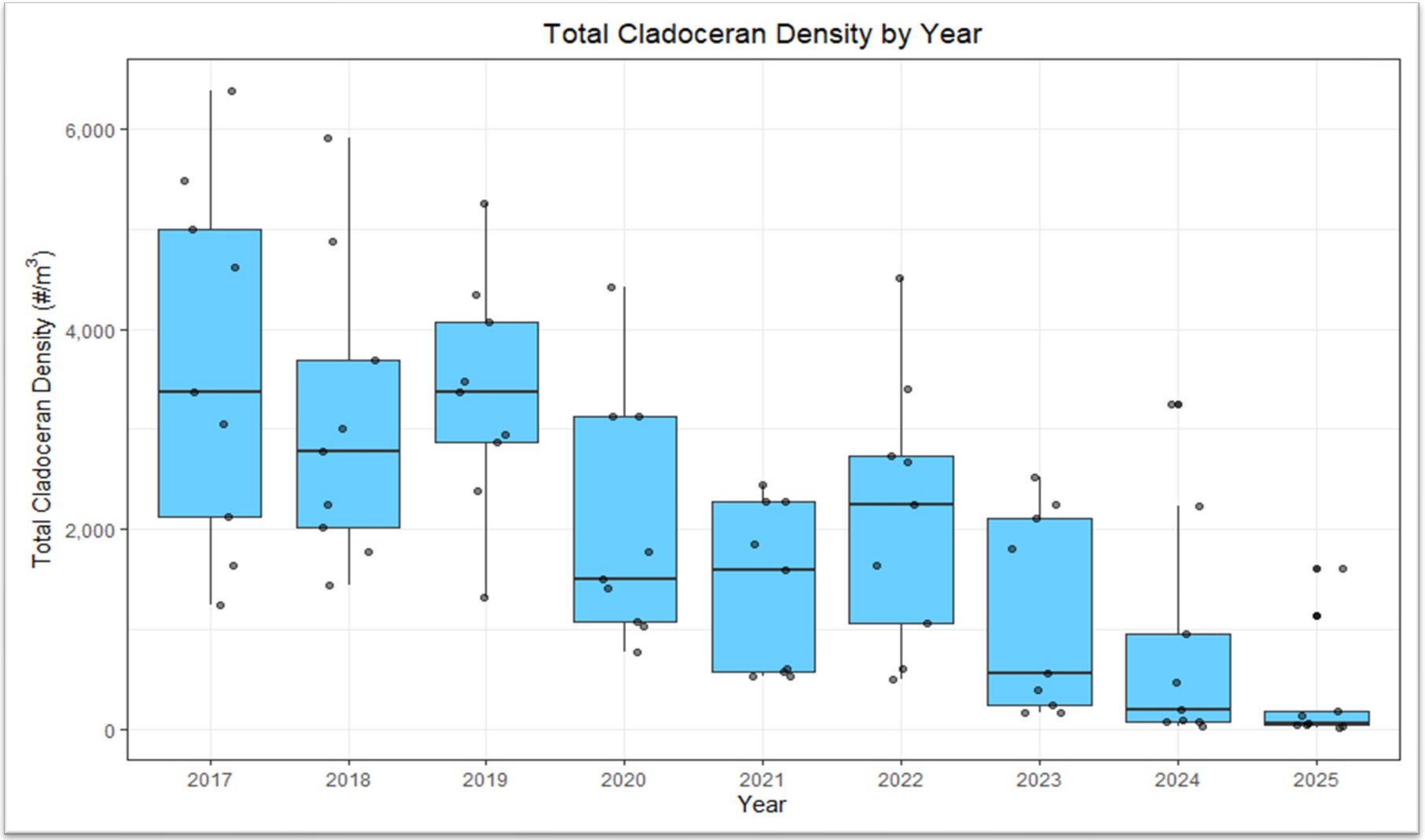
Spiny Water Flea Average Density

- No detects through 2022
- 0.39 #/m^3 in 2023
- 3.77 #/m^3 in 2024
- 1.78 #/m^3 in 2025



250-um mesh

Total Cladoceran Density Boxplot, 2017 – 2025
Mann-Kendall trend test: p = 0.005

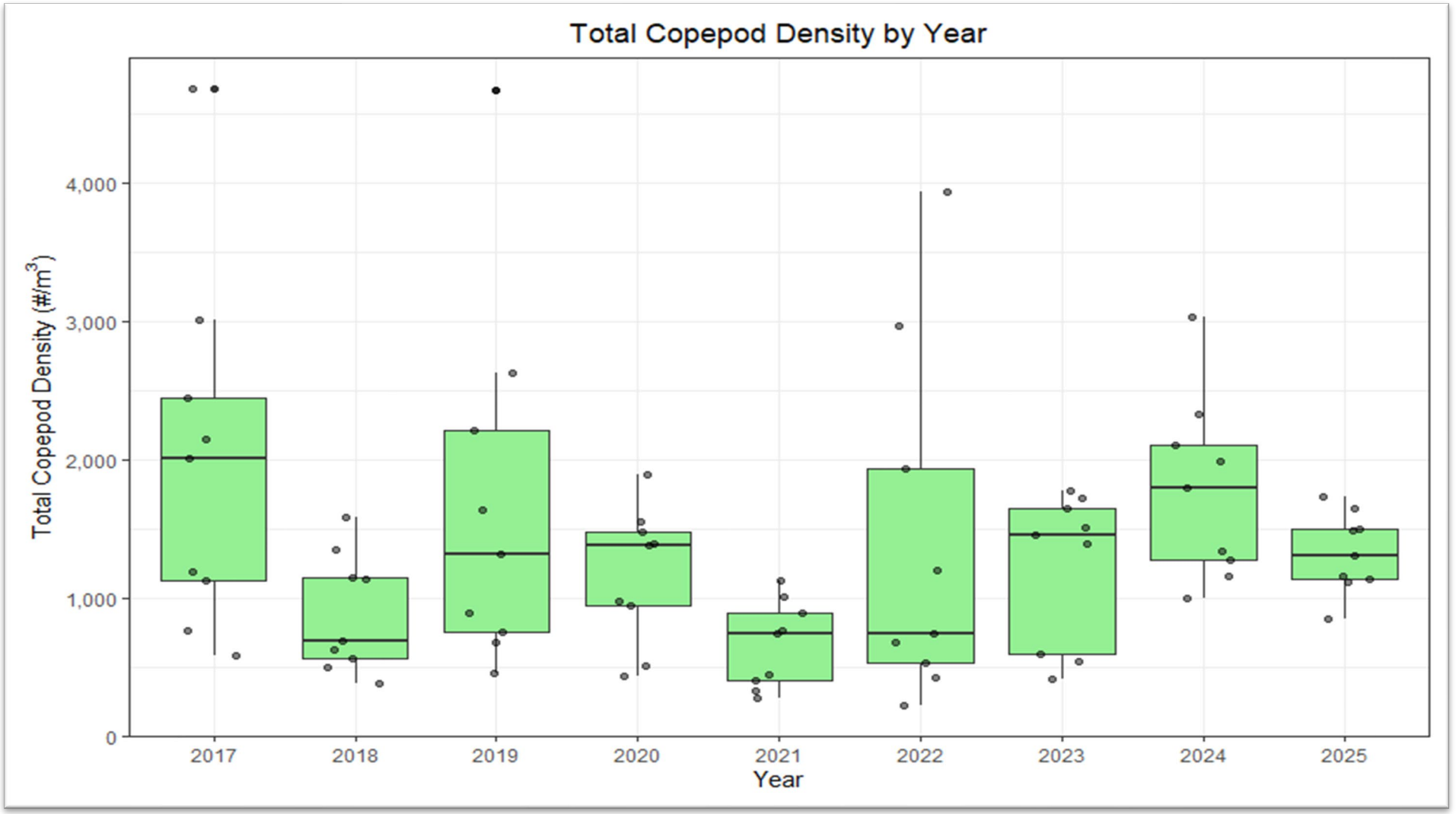


- ***Bosmina***
- ***Ceriodaphnia***
- *Chydoridae*
- ***Daphnia***
- ***Holopedium***
- ***Polyphemus***
- *Sididae*
- ***Leptodora***

Total Copepod Density Boxplot, 2017 – 2025

250-um mesh

Mann-Kendall trend test: p = 0.92

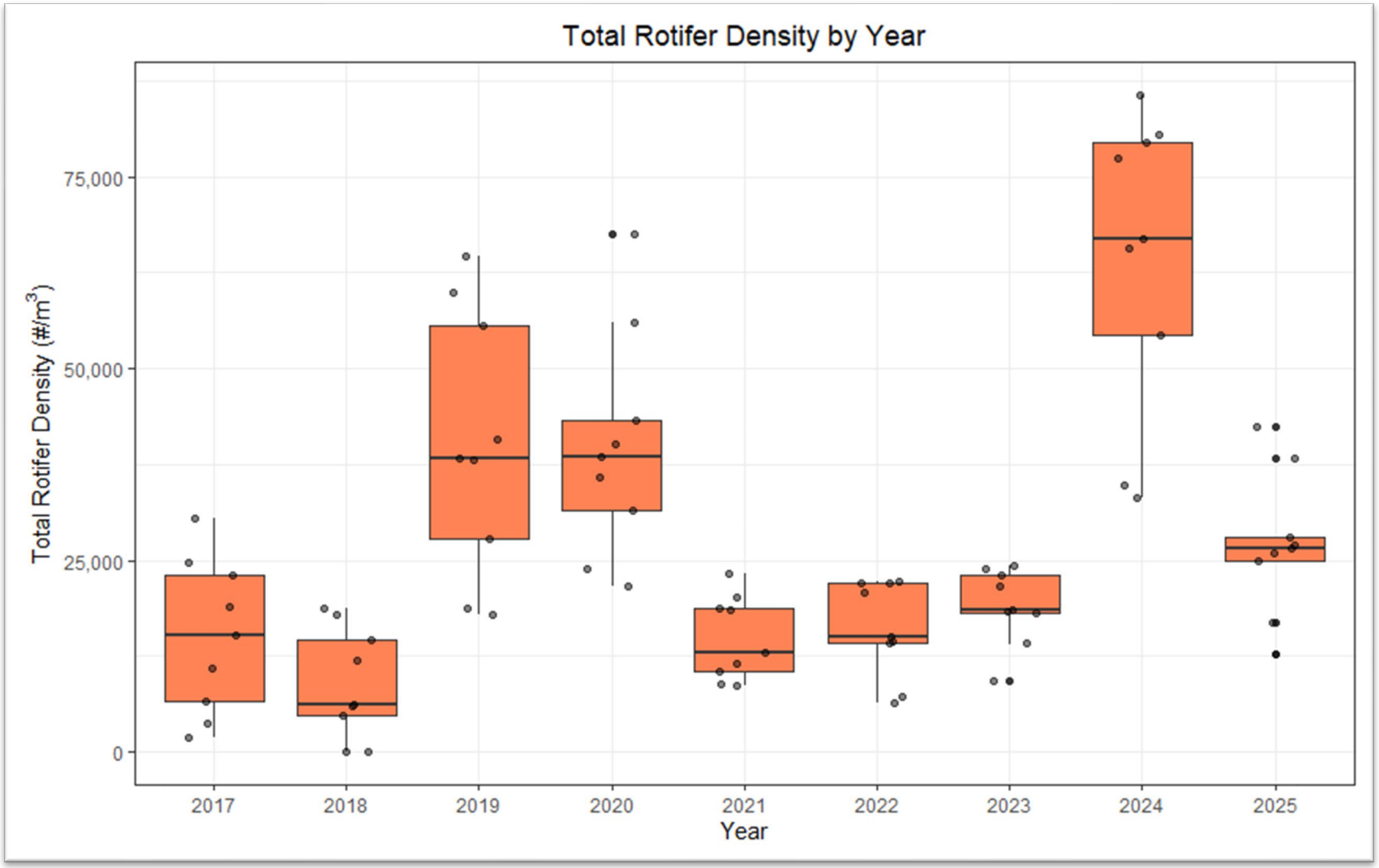


- *Calanoid*
- ***Cyclopoid***

Total Rotifer Density Boxplot, 2017 – 2025

80-um mesh

Mann-Kendall trend test: p = 0.25

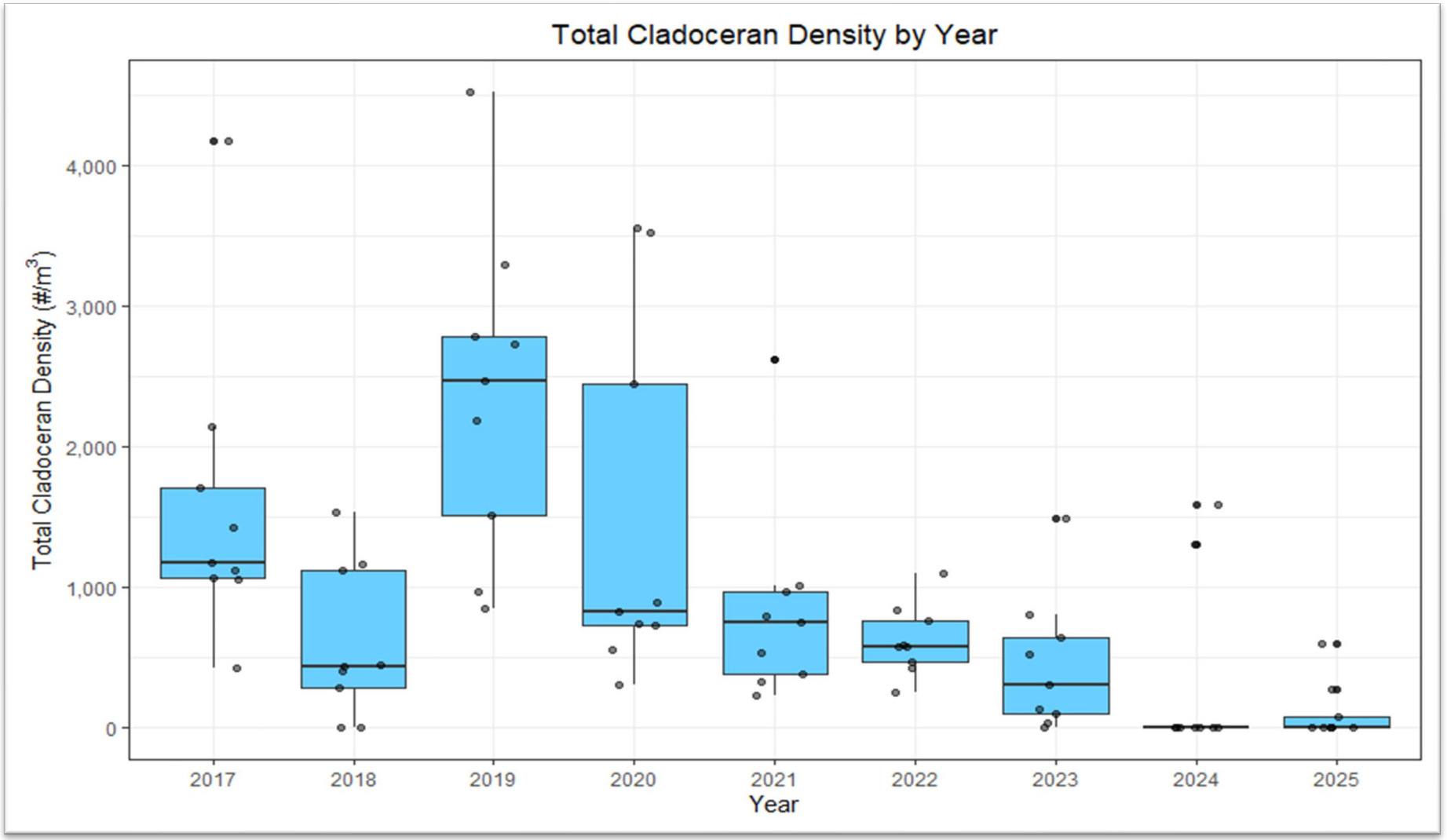


- *Asplanchna*
- *Brachionus*
- *Collotheca*
- *Conochilus*
- *Conochiloides*
- *Euclanis*
- *Filina*
- *Gastropus*
- *Kellicottia*
- *Keratella*
- *Lecane*
- *Poloesoma*
- *Polyarthra*
- *Synchaeta*
- *Trichocerca*
- *Pompholyx*

Total Cladoceran Density Boxplot, 2017 – 2025

80-um mesh

Mann-Kendall trend test: p = 0.012

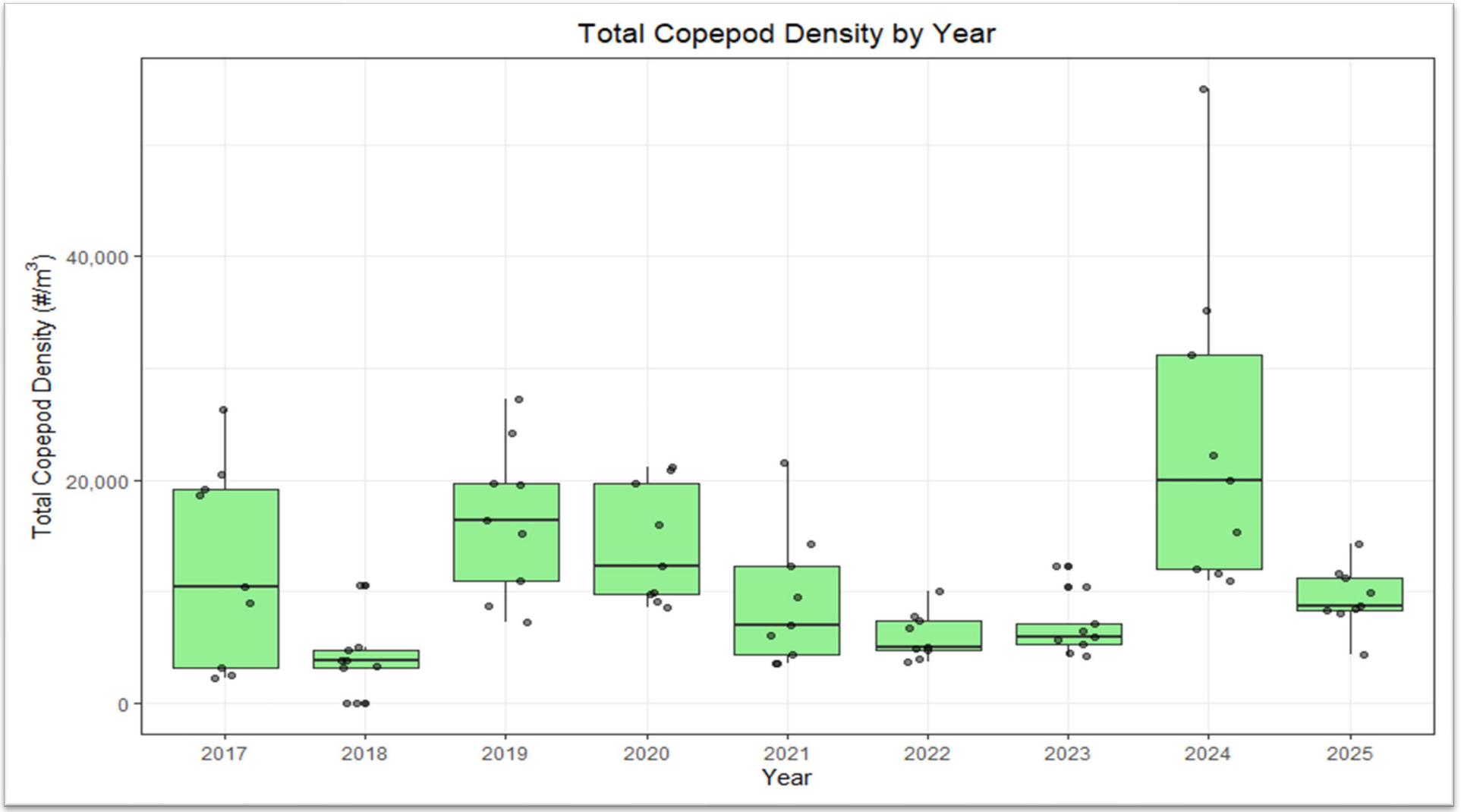


- ***Bosmina***
- ***Ceriodaphnia***
- ***Daphnia***
- *Holopedium*
- *Polyphemus*
- ***Sididae***

Total Copepod Density Boxplot, 2017 – 2025

80-um mesh

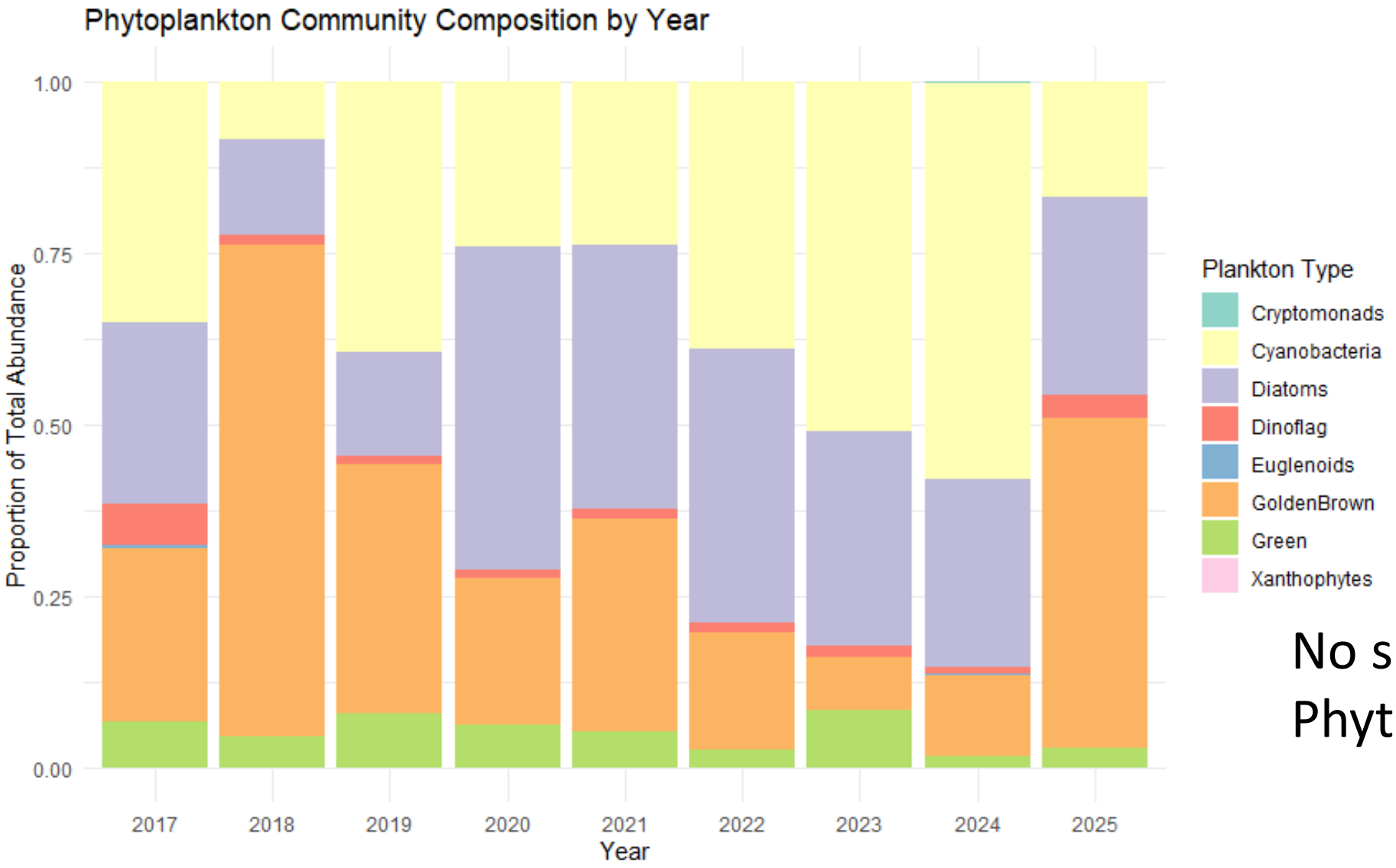
Mann-Kendall trend test: p = 0.917



- *Calanoid*
- *Cyclopoid*
- *Nauplii*

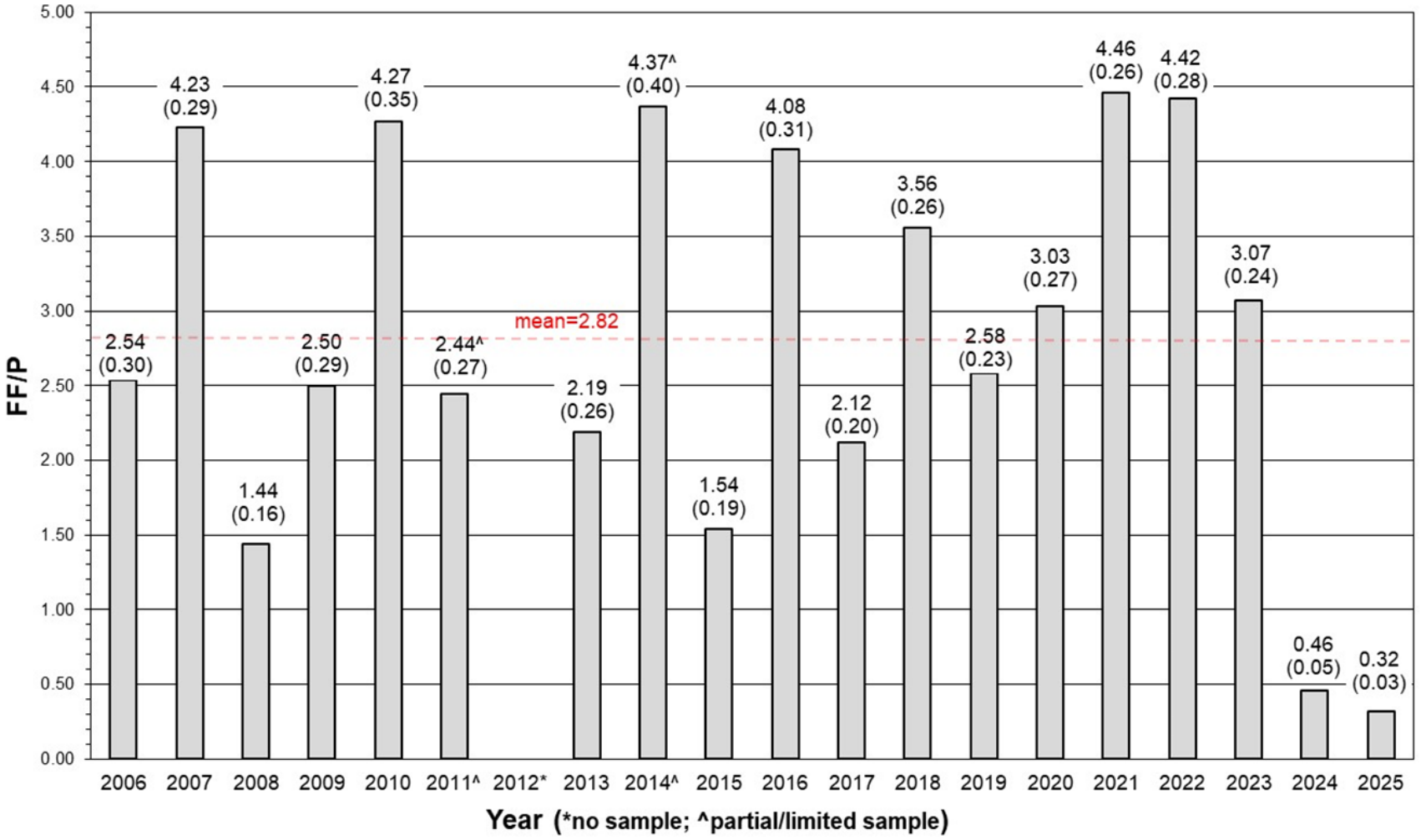
80-um mesh

Phytoplankton by Group Density Boxplot, 2017 – 2025



No significant trends by Phytoplankton Group

Lake Winnipesaukee Forage Fish Survey



Mean Number of Forage Fish per hydro-acoustic ping (FF/P),
with standard error (SE),
2006 - 2025

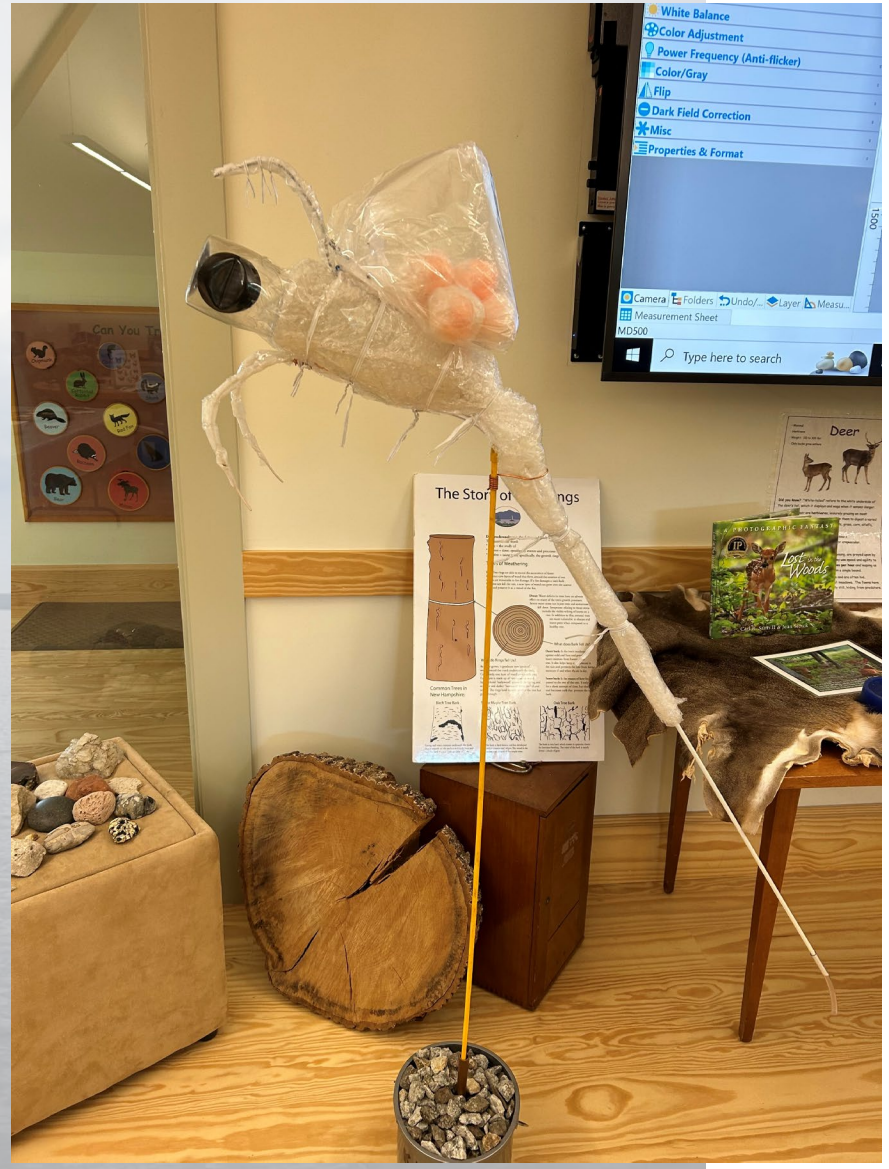
New Hampshire FISH AND GAME DEPARTMENT

Summary

- Spiny water flea density lower in 2025 than in 2024
- Significant decrease in 250-µm& 80-µm Cladoceran densities
- No significant trends in Copepod, rotifer, or phytoplankton groups
  - Significant decrease in Cyclopoid Copepods in 250-µm samples but not the 80-µm samples
- Low forage fish densities in 2024 & 2025

Next Steps Monitoring

- Annual Lake Winnipesaukee monitoring at 9 sites
- Do not have staff or funding to expand sampling
- Looking into eDNA partnership with UNH



Spiny Water Flea model created by a volunteer for the Lake Sunapee Protective Association. Photo credit: Amy Smagula

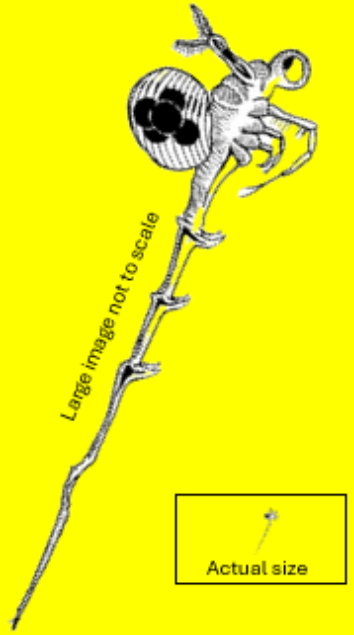
Next Steps
Education

- Encourage Clean, Drain, Dry
- New signage at boat launches
- Report sightings

Invasive Species Alert!

STOP THE SPREAD OF SPINY WATER FLEA BY:

- ✓ Wiping fishing lines and reels
- ✓ Draining and wiping live wells
- ✓ Draining and wiping bait buckets and other water containing devices
- ✓ Rinsing off your anchor and anchor line with clean hot water
- ✓ Allowing fabric or cloth items to dry between uses
- ✓ Cleaning (with hot water), draining and drying anything that comes in contact with water.



Spiny water flea is harmful for our lakes and the life in them.

Learn more:

NHDES

Report Invasives:

Next Steps
Collaboration

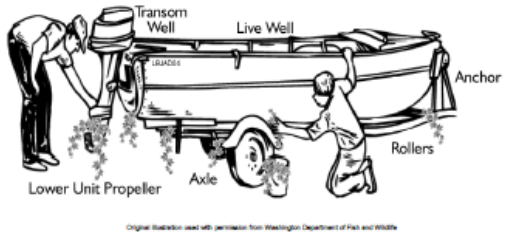
- Non-profit, university, & state collaboration
  - In-person meetings to discuss impacts, prevention
  - Aligning sampling methodology, including decontamination
  - Newfound Lake Region Assoc. – Plankton samples & eDNA monitoring
  - NLRA, Lake Sunapee Protective Assoc., Squam Lakes Assoc., Winnisquam Watershed Network - 'Stop the Spread' Swedish dishcloths
    - Will be handed out to anglers & boaters
    - Stocked at local tackle/boat shops
    - Template available for interested groups

Clean Boats Clean Waters

Before Launching
AND Before Leaving

CLEAN	DRAIN	DRY
off any mud, plants, and animals from boats, trailers, and equipment.	your boat and equipment away from the water.	anything that comes into contact with the water.

Never release plants, fish or animals into a body of water unless they came out of that body of water.



It is ILLEGAL to transport and introduce invasive aquatic species in New Hampshire. Violators are subject to fines.

Please report suspected invasive aquatic species sightings to NHDES at 603-271-2248.

What can YOU do?

- Clean, Drain, Dry!
  - NH LAKES maintains a map of boat friendly car washes: Boat Friendly Car Washes - Google My Maps
  - Mobile, solar-powered CD3 Waterless Cleaning Station
- Report sightings
  - First encounter usually from people who fish
  - NHDES' Invasive species coordinator
  - Aquatic Invasive Species Public Report Form
- Become a Lake Host

Questions & Comments

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See you this summer!